Belting Manual

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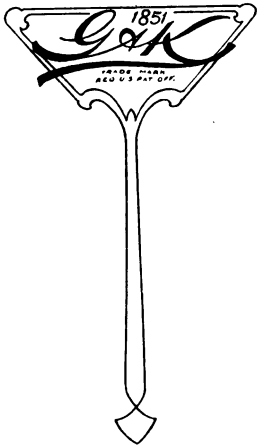


THE GRATON & KNIGHT MFG. CO.
WORCESTER, MASS., U.S.A.

FOURTH EDITION
1916

The Care of Belting

To obtain the highest efficiency in power transmission, has been and is still the problem which confronts every manufacturer. For years leather belting and gears were the best known power transmitting agents. During the past decade many substitutes have been placed upon the market, yet in the face of the most ambitious claims made for these substitutes, Leather Belting is still in the leading position, and likely to remain there indefinitely. It has demonstrated its ability to stand more abuse and come out "alive" than any other means of power transmission. It is an undisputed fact that if leather belting is given a tithe of the attention which of necessity must be given to other forms of transmission, it will demonstrate beyond question its greater efficiency and economy. To promote this efficiency and economy is the object of the following suggestions upon the care of belting.

Place the Belting in Charge of One Man

Our first suggestion we believe to be fundamental. It is that the care of the belting shall be entrusted to one man, that he shall be held solely and fully responsible for it, that no repairs or alterations of any sort shall be made or any dressing be applied except by him or under his immediate direction. No factory is so small and none so large but that this arrangement is a necessity. It is a necessity for a variety of reasons. In the first place it makes some one man responsible for the belting, thereby insuring that it receives attention when needed, and not when it is too late, for the " stitch in time " is eminently true in the care of belting and what is any man's business is no man's business. Secondly, it insures, as far as may be, uniform treatment of the belting, a powerful factor in determining its efficiency and life. Thirdly, it makes possible a full record of the efficiency, repairs, term of service, etc., of the individual belts—a matter of vital economic interest.

It is desirable to place in charge of the belting a man who has been trained in one of the factories where belting is made, and who has had a wide experience in the manufacture and care of belting. When this is not practicable, the man selected for the position should be given a short course of instruction either in a belt factory or under a competent belt mechanic, this instruction to cover the proper care of leather, the making of laps, the taking

up of belting, ordinary repairs, etc. Each factory should, of course, be provided with the necessary equipment for doing all ordinary belt work, the outfit required being neither very elaborate nor expensive. See page 5 for complete outfit of tools.

Have all Belting Periodically Inspected

It should be the duty of the belt man to make a careful and systematic inspection of all belting at definite, rather frequent intervals, and keep a record of the same. The inspection should be made to ascertain if any of the following conditions exist:

First—Whether belting is over-dry or saturated with oil.

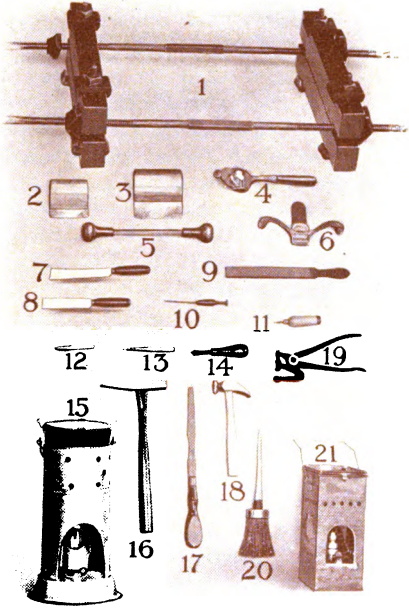
Second—Whether afflicted with an overdose of belt-dressing.

Third—If any laps have begun to open.

Fourth—Whether the belting is too slack and is slipping unduly.

Fifth—Whether the shafting is in line or if a guide has to be used to keep the belt on the pulleys.

Sixth—Whether the belt is so badly worn as to be in need of early replacement.



Complete Outfit of Tools

1. Clamps and Rods.
2. Belt Scraper.
3. Slicker.
4. Belt Hoe.
5. Turning Steel.
6. Belt Shave.
7. Long Skiver.
8. Heel Chop.
9. Knife Sharpener.
10. Steel Sharpener.
11. Awl.
12. Drive Punch.
13. Blind Punch.
14. Staple Puller.
15. Glue Kettle.
16. Ripping Hammer.
17. Screw Driver.
18. Pegging Hammer.
19. Hand Punch.
20. 3½-inch Best Glue Brush.
21. Safety Copper Glue Kettle.

Tools used by G & K belt repair men

How to Remedy Some of the Belt Troubles

When belting appears the least bit dry or harsh the belt should first be carefully cleaned of surface dirt; this usually may be accomplished by rubbing with a cloth, damping the cloth with kerosene is sometimes of assistance. In bad cases a wooden or metal scraper may be necessary to remove accumulated dirt, but in any event a clean leather surface should be obtained. This should then receive a light coat of dressing on both sides of the belt; we would recommend Royal Worcester Belt Preservative (see page 8). This first light application should be allowed to work in thoroughly before more is applied. The applications should be repeated until the leather has that mellow but not greasy feeling characteristic of proper working condition. In cases where belting is exposed to moisture, or where it is accidentally wet or particularly where the belt works under such conditions that it is first wet and then dry, a little attention in the way of wiping off surface moisture, and applying a light coat of Royal Worcester Belt Preservative to the still damp belt will work wonders in the way of prolonging its life. The sticky belt dressings are usually to be avoided. In rare instances they may be immediately useful, but if used to any extent they stick the belt to the pulley so tightly, that the grain is pulled off the belt, or working into the leather they rot it and shorten its life.

When in doubt consult our Engineering Department

Where moist or wet conditions are to be encountered, Neptune or Spartan Belting should be used. See pages 84 and 87.

Belt Records

By keeping simple records and following the foregoing instructions for a period of three years, a large saving in the annual belting expense has been effected, in some instances as high as fifty per cent. This includes only the first cost of the belting, labor and material used. Were it possible to estimate the increased output of machines due to more continuous operation without breakdowns, the results would be still more remarkable.

To aid belt users to effect a similar saving and prove that " best quality means least cost per unit of production " our Engineering Department has prepared several belt record systems to meet different requirements. These systems vary according to the size and kind of factory, number of belts used, etc. By the use of such records, every plant, large or small, will be greatly benefited.

If you will advise us the size of your plant, type of machinery, number of belts used and the conditions under which they operate, we will furnish you a system best suited to your particular requirements. Our Engineering Department will gladly assist you in installing the belt record system or in the selection of belts calculated to render the greatest service. Consult us freely.

Comparative records of belt service lead to general adoption of G & K Belting

Royal Worcester Belt Preservative

This is a semi-liquid compound prepared from our own private formula. It penetrates and preserves the fibres of leather. It will keep belts in a pliable condition, prevent slippage, prolong life, enable belting to grip the pulleys firmly and to transmit power efficiently.

This preservative is easily and quickly applied and is decidedly economical in use. We guarantee that it is absolutely free from substances injurious to leather. It will protect the laps and plies where the belts are used in damp places, providing the belts are given a thorough dressing once a month.

Royal Worcester Belt Preservative is put up in gallon and half gallon pails.

Directions

Wipe the belt clean, put a little of the Preservative on a piece of cotton waste and apply to the moving belt. The Preservative is effective applied either cold or warm, but if warmed gently until liquid and then applied, it penetrates somewhat more quickly. When belting appears dry or harsh it should receive a light coat of the Preservative on both sides. This application should be allowed to work in thoroughly and then be repeated until the leather has that mellow, but not greasy, feeling characteristic of proper working condition.

Star Bar Belt Dressing

is the best dressing in stick form for quickly stopping belt slippage. It is economical and is easily and quickly applied to the belt while in motion.

Star Bar Belt Dressing is put up in boxes containing twelve bars, each bar weighing about 1 lb.

Directions

Cut wrapper from the end of bar, apply the dressing uniformly and thoroughly to the working surface of the belt while in motion. Care should be used not to put on too much.

Avoid Oils, Greases, Etc.

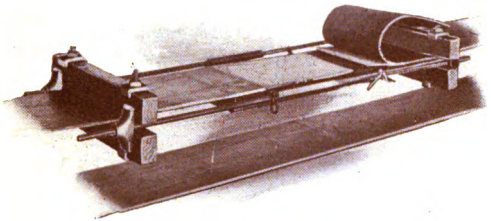
Too much grease is injurious to leather. Mineral oils, in particular, rot leather rather rapidly, and where belting is liable to become soaked with oil, mechanical means should be taken to keep the oil from the belt. Where this is impossible, the belt should be removed from time to time and the oil extracted with some solvent, such as naphtha or carbon tetrachloride. Packing the belt in dry sawdust or shavings or some similar absorbing material

will sometimes answer the purpose. If it is not possible to remove the belt, wiping it while on the pulleys with a dry cloth or waste or some such absorbent will help. Machine oil, besides its tendency to rot leather when present in excess, gives a bad frictional surface, leading to excessive slipping. An excess of oil also has a tendency to injure the sticking qualities of the ordinary cements used in making belting. Frequently, from this or other causes, laps start up at the points, a result sometimes due to running belting in the wrong direction. All belting should be run so that the point of the lap on the outside surface of the belt points opposite to the direction in which the belting is run. To whatever cause the trouble may be due it should be given early attention. Spartan Belting resists the action of oil and gases better than any other belting on the market. See page 87.

Repairing Laps

In the case of oily belts it will be necessary to degrease the parts to be joined together or the cement will not stick satisfactorily. Do not think you are repairing the trouble if you drive a string of tacks through the joint. This is simply making a bad matter worse, for the leather will probably break where you have applied the tacks. There is a right and a wrong way of repairing laps as well as of lapping the ends of a belt together when first installed, and the quickest and easiest way is by no means the most economical in the end. It is very

easy to drive a heavy cast iron belt fastener into a piece of leather, but it is just as well, before doing so, to think how much you will weaken the belt at that point, and how much service you will lose from your machine by the jump of the belt every time that chunk of metal goes around the pulley. The most satisfactory method of joining belting is by making a cemented lap or joint. This is a surprisingly simple process once a man knows how, and given the man and the training advised there is no reason why nearly every belt in a factory should not be joined together in this way.



Directions for Making Double Belts Endless on the Pulleys

Draw the belt over the pulleys, being sure that the laps on the outside of the belt point in the opposite direction to that in which the belt runs, bringing the ends into the most convenient position for cementing the belt together. Place the wooden clamps on the belt, one of them about 6 inches back

G & K Belt Clamps are simple and convenient to operate

of the end of the outside lap, and the other one as far away from the inside or wedge-shaped lap as the length of the rods will permit. Be sure and have the belt exactly in the center of the clamps and the clamps applied perfectly square with the edge of the belt; place the rods in the clamps and draw the belt up a little tighter than you desire it when running to allow for slack between clamps, say about 2 inches. Obtain a board just wide enough to go between the rods and long enough to extend under the entire lap, strap it to the rods in such a way that you can shave the lap down and fit it together. After the lap is all fitted, and before you commence cementing the belt together, see that it is perfectly straight, and, if not, draw up on either one of the rods enough to bring it into line and refit the lap, if necessary.

Be sure that the cement is very hot, not boiling, and not too thick. Apply the cement to both surfaces of the under part of the lap and rub it in thoroughly, being careful not to apply too much of it. Do not attempt to cement too much surface at a time and do not allow the cement to become chilled. If in a cold place it is well to warm the belt by means of a blow torch, being extremely careful not to burn the leather during the operation, or the board upon which the gluing is done may be thoroughly warmed before it is placed under the belt. On large belts it is best to cement a few inches at a time, rub and hammer it down thoroughly, proceeding a little at a time in this way until the entire lap has been cemented.

As soon as the cement is properly applied get the lower portion of the lap together, rub it with a slicker and hammer it down with an ordinary peg-

ging hammer, paying particular attention to the edges and ends. After the lower side of the lap is thoroughly cemented, go over the upper side in the same manner, being particularly careful to see that both sides of the lap come in contact at all points and are well rubbed and hammered down. It is absolutely necessary that the lap be well rubbed down, otherwise a pocket will be left in the lap which will eventually extend throughout the belt, causing it to separate in the plies. Air pockets of this kind are the most frequent cause of double belts separating on the pulleys. After this is done let the lap set about half or three-quarters of an hour, if it is in an ordinary dry atmosphere, when it will be safe to take the clamps off and start the belt if necessary. A little longer time to set would be desirable if it can be conveniently allowed, but with our Royal Worcester cement it is not absolutely necessary.

Royal Worcester Belt Cement

is the cement used in the manufacture of our belting. It is superior in quality, unusually tenacious, and

will not deteriorate with age or extremes of climate. It sets very quickly, enabling a belt to be put in operation with the least possible delay.

This cement is prepared in gelatine form and for use should be reduced with hot water to the consistency of light molasses. It is put up in both one and five pound cans.

Directions

Place the vessel containing the cement in a kettle of boiling water and reduce the cement with hot water to the consistency of light molasses. Keep hot while using. Apply with a brush, rubbing both surfaces of the lap well. Do quickly a small portion only at a time, as the cement will not be effective if it becomes chilled. Place the joint on a hard, smooth surface and tap lightly with a hammer until the cement has set.

Royal Worcester Belt Cement sets very quickly, enabling a belt to be put in operation with the least possible delay.

Neptune Belt Cement

is the cement used in the manufacture of our waterproof brands of belting, viz., Neptune, Special Planer and Spartan. Neptune Cement not only possesses wonderful adhesive qualities but is absolutely unaffected by dampness or weather. It is furnished in

liquid form ready for use, and is put up in air-tight tin cans, one pound of cement in each.

Directions

First. Scratch up the fibre on the lap. Then apply a thick coat of this cement to the entire lap for sizing, unless the lap has already been sized. Allow this sizing coat to dry hard one-half hour at least is required.

Second. Apply a thin coat of cement to as much of the lap as the clamp (see below) will hold, using great care to moisten evenly with the cement every part of both surfaces to be joined. The cement must be applied and the clamp adjusted as quickly as possible as this cement dries very rapidly on the surface, though it takes considerable time to set in the lap.

Third. To secure a good "stick" it is imperative that the parts of the lap, after coating with cement, be pressed strongly together. Pounding with a hammer will not do under any circumstances. It is, therefore, necessary to use a clamp similar to a belt clamp, having a smooth face and wide enough to press about six inches of the lap at a time. Enough of the lap is cemented at one time to fill the clamp, which then is screwed down tight and allowed to set one-half hour. The clamp is next loosened, drawn back one-half inch and tightened while another six inches of the lap is moistened with cement. Then the clamp is adjusted to this section, etc.

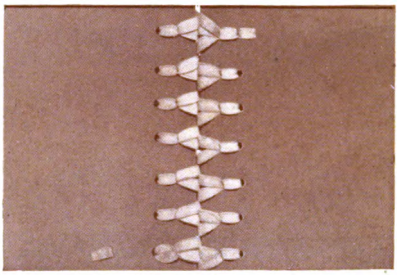
Fourth. No tension must be put on the belt for at least six hours after the cementing is complete.

Caution

Neptune cement must not be used near any flame, and must be kept in an air-tight container to prevent any evaporation. Both brush and container must be clean and dry, and the leather to be cemented must be perfectly dry.

Next best to the cemented joint is perhaps that made with rawhide or other lace. But this joint, again, must be made properly and by some one who knows how. Large lacing holes and a big bunch of lace may be almost as harmful and wasteful as a chunk of cast iron. Where belting is exposed to moisture and a waterproof cement not accessible, lacing may be resorted to, but in general all joints should be cemented. Cemented joints mean increased life of the belt, smoother running, fewer repairs and greater machine production.

Directions for Lacing Belts "Hinge" Plan



"Hinge" lace looks the same on both grain and flesh sides.

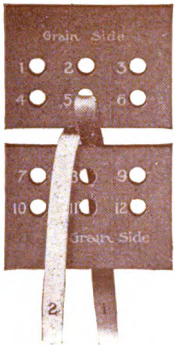
Cut the ends of the belt to be joined perfectly true with a tri-square. Punch two rows of holes in each end of the belt. The holes in the second row should be punched directly back of those in the first row. The holes in both ends of the belt should also be exactly opposite.

No holes should be less than ½ inch from the edge of the belt, nor nearer the end than ½ inch. The holes should be spaced about ¾ inch from center to center.

For widths of lacing to use and proper sizes of holes to punch for various widths of belting see page 24.

Directions for Lacing

Put lace through hole No. 5, drawing ends even. Butt the ends of belt together and pass each end of the string of lace between the ends of the belt, as shown in following illustration.

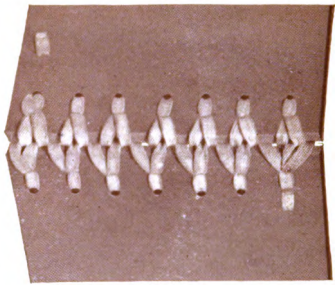


Pass No. 1 lace up through hole No. 8, down between ends of belt, up through 5, down through 2, up through 5, down between ends again.

Put lace No. 2 down through hole No. 8, up through 11, down through 8, up between ends, down through 4, up between ends, down through 7, up between ends, down through 4, up through 1, down through 4, up between ends, down through 7, up through 10, down through 7, up between ends, down through 4, up through 1. Punch hole with belt awl and fasten in usual manner directly back of hole No. 1.

To finish the other side put lace No. 1 up through hole No. 9, down between ends, up through 6, down between ends, up through 9, down through 12, up through 9, down between ends, up through 6, down through 3, up through 6, down between ends, up through 9, down through 12, then fasten end of lace back of hole No. 12 in the usual manner.

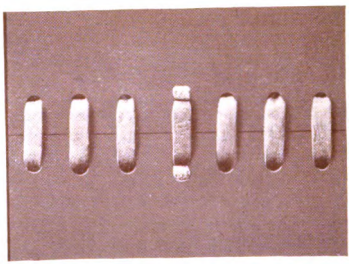
The illustration used with these instructions shows only three holes to each row. The same instructions



The "Hinge" plan of lacing does not produce a stiff and clumsy joint; on the contrary, the joints are very pliable.

apply whenever any odd number of holes are required to each row; simply start with the center hole.

When the width of the belt requires the use of an even number of holes in each row, begin with either one of the two center holes and follow the instructions already given.



Showing "Straight Stitch" Lace on Grain Side of belt

Properly laced G & K Belting runs straight

Directions for Lacing "Straight Stitch" Lace

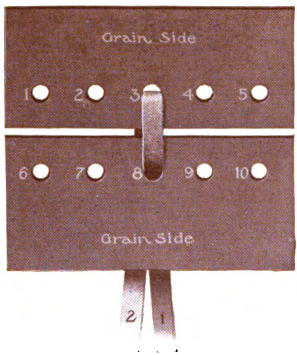
Cut the ends of the belt to be joined perfectly true with a tri-square. Punch one row of holes in each end of the belt. The holes in both ends should be exactly opposite.

No holes should be less than ½ inch from the edge of the belt, nor nearer the end than ½ inch. The holes should be spaced about ¾ inch from center to center.

For widths of lacing to use and proper sizes of holes to punch for various widths of belting see page 24.

Directions for Lacing

Butt ends of belt together. Put lace through holes No. 3 and No. 8 from the grain side, drawing ends of lace even, see illustration.

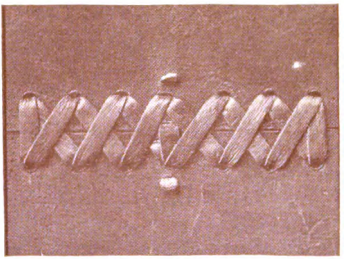


Put No. 1 lace up through hole No. 3, down through 8, up through 4, down through 9, up through 5, down through 10, up through 5, down through 10, up through 4, down through 9 and up through 3. Punch hole with belt awl and fasten in usual manner directly back of hole No. 3.

Put lace No. 2 up through hole No. 7, down through 2, up through 6, down through 1, up through 6, down through 1, up through 7, down through 2 and up through 8. Fasten lace in usual manner directly back of hole No. 8.

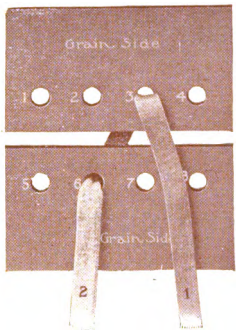
The foregoing illustration shows five holes to each row. The same instructions apply whenever any odd number of holes are required to each row—simply start with the center holes.

When the width of the belt requires the use of an even number of holes in each end of the belt, lace in accordance with the following directions:



Showing "Straight Stitch" Lace on Flesh Side of belt

Butt ends of belt together. Put lace up through holes No. 3 and No. 6 from the flesh side, see illustration, drawing ends of lace even.



Put lace No. 1 down through hole No. 7, up through 4, down through 8, up through 4, down through 8, up through 3, down through 7, up through 2. Punch hole with belt awl and fasten directly back of hole No. 2.

Put lace No. 2 down through hole No. 2, up through 5, down through 1, up through 5, down through 1, up through 6, down through 2, and up through 7. Fasten lace in usual manner directly back of hole No. 7.

The illustration, herewith, shows only four holes to each row. The same instructions apply whenever any even number of holes is required to each row.

Royal Worcester Lace Leather

is made from hides taken from young animals and carefully selected to secure freedom from cuts, grubs and other imperfections.

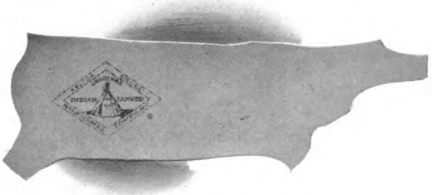
It is a strictly mechanical lace leather, " worked " by special machinery of our own design and construction, and hand finished by skilled workmen. This process renders the leather very pliable, toughens the fibres, and gives to the surface a soft, kid-like finish.

The absence of chemicals in the process of making this leather insures long life for the lacing, and adapts it to any climate, because it will not gather moisture and mildew in damp weather, nor deteriorate or harden with age.

Royal Worcester Lace is thoroughly stretched during the several stages of the manufacturing process, and hence does not stretch in use.

The sides are closely trimmed and the number of square feet determined by sworn leather measurers, so that accurate measurements are guaranteed.

Royal Worcester Lace Leather is unquestionably the best value obtainable in lace leather.



Kelton-Bruce
Original Indian Tanned Lace Leather

This lace leather was introduced by the Kelton-Bruce Manufacturing Co., in 1871, and was manufactured by them at their plant at Salem, Mass., until 1910. In July of that year The Graton & Knight Mfg. Co. acquired the business and good-will of the Kelton-Bruce Mfg. Co., and is now the sole manufacturer of the Kelton-Bruce Original Indian Tanned Lace Leather.

The resistance of this leather to the harmful effects of time and climate, its uniformity in thickness, excellent tensile strength and durability have made this lace the recognized STANDARD of TANNED lace leather.

The sides are well trimmed and the number of square feet determined by sworn leather measurers, so that accurate measurements are guaranteed.

Hand Cut Lacings

Our Hand Cut Lacings are well balanced, and are put up in bundles containing 100 feet each in widths from $\frac{1}{4}$ inch to $\frac{3}{4}$ inch, inclusive, full measurements guaranteed. These Cut Lacings can be had in either the Royal Worcester or Indian Tanned Brands.

Lacing Specifications

Punch Nos.	Exact Size	Diam. of Hole	Recom'd Width of Lace	Width of Belt	Weight of Lace
6		11/64″	¼″	Up to 5″	Light
7		3/16″			
8		¼″	5/16″		Light
9		9/32″	3/8″	6′ to 14″	Medium
10		5/16″	7/16″		Medium
11		3/8″	½″		Heavy
12		13/32″	5/8′ & 3/4″	14″ & over	Heavy

Some belt men use but two sizes of punches (No. 9 and No. 11) for all widths of laces. If a hole larger than the punch is desired, it may be cut as shown in illustration. The long way of the oval hole should be parallel with the edge (not the end) of the belt.

Do not use a punch larger than necessary to draw in the lace.

Royal Worcester Lace is thoroughly stretched

Selection of Belting

A belt should be capable of transmitting from 5 per cent. to 25 per cent. more power than is actually needed; the excess capacity being governed by the type of drive, ranging from 5 per cent. for heavy main drives to 25 per cent. for machine belts.

Never use belts full width of the pulley face as a slight misalignment may cause part of the belt to run beyond the edge of the pulley and perhaps against a shifting finger or pulley flange, resulting in loss of power and frequently in a badly damaged belt.

A belt too narrow necessitates high tension to transmit the required power, thus causing excessive journal friction, consequent loss of production and the early destruction of the belt. Thin, wide belts give the best service working vertically. A thick, narrow vertical belt will not grip the pulley well.

In general, single belts, if heavy enough to carry the load, should be used on small pulleys. A single belt should never be used where the width is more than 1⅓ times the diameter of the smallest pulley. Where small diameter pulleys and the load would require an unusually wide, single belt, it is advisable to substitute narrower pulleys and a narrower light double belt.

Double belts of medium or heavy weight, generally speaking, should never be used on pulleys less than 12 inches in diameter, and it would be better to adopt 20 inches as the minimum diameter.

Belts too heavy for the load weave back and forth on the pulleys. This is best illustrated by a belt working under intermittent loads, the belt

running straight while carrying the maximum or proper load, but showing a tendency to weave when the load is considerably reduced.

Belting made from center stock leather (first quality belting) should be used to carry heavy loads or where the conditions are unusual. For certain light work or underloaded countershaft work, side stock or even shoulder stock belting (second quality) will often meet the requirements satisfactorily.

Do not, however, be deceived by so-called first quality double belting made with one-ply center stock and one-ply shoulder stock; the two cuts and qualities of leather do not stretch uniformly and a belt so constructed will soon give trouble.

Oak tanned Leather Belting is recognized as the best belting for ordinary conditions. For overloaded drives, where it is not feasible to get greater power by increasing the belt speed or the width of pulleys to enable the use of wider belts, recourse must be had to our Spartan Brand of Belting, remarkable for its pliability and consequently increased pulley grip and its great tensile strength. Where abnormal external conditions exist Spartan Belting should be used, as the specially tanned leather and the special cement used in its construction resist the injurious effects of water, heat, steam, oil, gases and acid fumes.

The foregoing suggest only a few of the problems which must be met in installing a drive of maximum efficiency, but it illustrates the importance of carefully considering this question. Our Engineering Department is ready to solve any transmission problem, investigate or design any drive upon request. If you have certain belts or drives which are a source of annoyance and expense, consult us.

Avoid Putting on Belts too Tight

The tightness with which the belts are put on the pulleys is of fundamental importance. If too tight there is a large unnecessary loss of power from excessive friction at the bearings, to say nothing of the fact that the leather is over-strained and injured. On the other hand, if too loose the belt is liable to flop around and jump from the pulleys, particularly when working where a load is suddenly thrown on or off. When the belts are put on and taken up under the direction of one man, the errors of too tight and too slack belting are avoided and a uniformity of belt tension exists throughout the factory which can be obtained in no other way. Of course it is evident that the slacker a belt can be run up to a certain point and do its work satisfactorily, the greater the economy. In installing belting and taking it up, consideration must be given to the fact that certain, kinds of belting are affected by weather conditions lengthening and shortening according to the amount of moisture in the air. This is particularly true of certain makes of chrome leather belting, and instances have been known where babbitt has been melted out of boxes, or even shafting has been pulled down, as a result of such belting having been put on too tight.

Shafting in Line

Be sure to note carefully whether your shafting is properly in line. Probably more belting is ruined by improperly lined shafting and pulleys than in any other way. The belts under this condition are either kept on the pulleys by guides or rub against hangers or portions of machines until a lap is started open, thus catching the belt and tearing it or stretching it excessively on one edge. Belts so stretched will not run straight and are apt to run off the pulleys and become torn.

Remember that because shafting was once in line it does not follow that it stays so indefinitely.

Changing loads on the floor is apt to put shafting out of line. Frequent inspection of shafting for alignment is always rewarded by a large saving in the friction load.

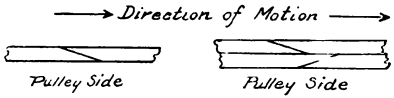
In all replacements, as well as in the original installment, initial economy should not be the only thought. It is a very simple matter to connect two pulleys by a band in such a way that when one pulley is turned the other will go round. It is not at all a simple matter to properly proportion a drive and to select the size and quality of belting which will transmit power most efficiently and economically. Yet the problem seems so simple that it more frequently than not fails to receive the necessary consideration and a common result is that belting is condemned when really the man should be condemned who asks the belt to work under given con-

ditions. Most belt troubles would never appear if the design and installation of the belt equipment were placed in competent hands. It may be stated as a general rule that the use of the best quality belting, of weight and pliability adapted to the work required, will pay good dividends in lessened repairs, increased life of belting and increased output of machines. The usual tendency is to employ a single belt, which is too light, and a double belt, which is too heavy for the work required.

To Secure the Best Results

Single Belts should be put on so as to run with the grain, or hair side, next to the pulleys, and so the points of the laps will run against the pulleys, as the laps on the outside of a belt are most liable to come apart when the points are run against the atmospheric pressure.

Double Belts should be put on so that the points of the laps will run with the pulleys, as both sides point in the same direction. (See illustration.)



For quarter-turn belts the details of the drive must be analyzed. The belts must be specially constructed to give satisfactory service. A quarter-turn drive without an idler requires a differently constructed belt from one with an idler.

For quarter-turn drive without idler, the pulleys must be set so that the point where the belt is received on the driving pulley and the point where the belt leaves the driven pulley will be in a plumb line. In this arrangement the belt can be run in only one direction. Any attempt to drive the belt in the reverse direction will result in its being thrown from the pulleys and probably ruined.

On quarter-turn belts specially constructed for drive without idler, one edge is marked as follows: "Run this edge on long side of the drive." This edge must run on the longer side of the drive to give satisfactory results.

Location of Shafts from Pulleys

Care should be exercised in locating shafts so that they are not too near together; there should be distance enough between them to allow the belt to recover somewhat from the strain applied on the tight or working side. This distance depends entirely upon the size of the belts and pulleys, but should be sufficient to allow some slight sag to the slack side of the belt. It is also injurious if the shafts are too far apart, for in such cases the weight of the belt draws heavily upon the shafting and increases the friction load in the bearings. At the same time it causes the belt to swing from side to side, frequently to such an extent that it nearly runs off the pulleys. This constant swinging from side to side

is also a frequent cause of crooked spots developing in belting. If possible, the shafting and machinery should be so installed that the tight side of the belt is at the bottom, so that whatever sag there may be in the belt will tend to increase the arc of contact on the pulleys.

It is the best and most economical practice to use pulleys of large diameter, thus obtaining a high belt speed, which means a saving both in the transmission of power and the wear and tear of the equipment.

The speed of the belt being the same, the diameter of the pulley has a slight effect on the amount of power transmitted, the difference being in favor of pulleys of large diameter.

The speed of the shaft being the same, the advantage in favor of large pulleys over small pulleys is in proportion to their diameters.

Cover Pulleys with Leather

Covering pulleys with leather reduces the slipping of belts and also decreases the friction losses in belt driven transmission by making it unnecessary to run the belts so tight. It is estimated that leather covered pulleys will enable belting to transmit thirty per cent. more power than pulleys with the plain iron surface.

Directions for Covering Small or Medium Size Iron Pulleys with Leather

Be certain that the pulley is absolutely free from grease by washing it with naphtha, gasoline or some

similar material. Be sure that the pulley is reasonably warm and dry. Where possible, make the cover endless, about $\frac{1}{8}$ inch to the foot shorter than the circumference of the pulley. Place the endless cover on the pulley, pushing it on, say one inch or more, then thoroughly glue the exposed inside surface of the cover and the exposed outside surface of the pulley, being sure that the glue is very hot, but not boiling, and not too thick; rub the cement thoroughly into the leather and also onto the pulley. As soon as you have these surfaces glued take the pulley by the spokes and drive the cover on by striking it on the floor or bench. Do this as quickly as possible, but carefully, for if you strike too hard it will bend the leather so that it will be impossible to drive it on. If it sticks a little, use a screw driver between the cover and the pulley and force it down, using the screw driver as a lever.

As soon as the cover is completely on, thoroughly rub the edges of the cover with a round hickory stick, or handle of some kind, so as to make a good contact between it and the edge of the pulley. This serves to work out the air and surplus cement.

An experienced man can cover a pulley in this manner so tight that it will not need rivets, although it is customary as a matter of safety to use a few copper rivets.

Let the pulley set two or three hours before using.

We prepare a special Pulley Covering Cement for this purpose.

We have tried to offer a few suggestions for the proper care of belting, and we may summarize these briefly as follows:

Place the belting in charge of one man.
See that he knows his business and attends to it.
Have all belting periodically inspected.
Remedy all faults in their early stage.
Keep all driving surfaces clean.
Put grease into too dry belting.
Take grease out of too oily belting.
Avoid sticky dressings.
Run all belting as nearly as practicable at a uniform tension.
Run belts as slack as they will work efficiently.
Keep all shafting rigidly in line.
When in doubt consult our Engineering Dept.

Mechanical Rules Regarding Belting

Rule No. 1. *To find the belt speed in feet per minute.*

Multiply the diameter of the pulley in inches by 3.1416 and again by the number of revolutions per minute of the pulley, and divide by 12 to get the result in feet per minute.

For convenience in finding belt speeds the tables on pages 44 to 47 inclusive have been compiled from which the belt speed in feet per minute can be found, when the diameter of the pulley in inches and the number of revolutions per minute of the same are known.

Rule No. 2. *To find the horse-power belting will transmit when the drive is open (without idlers) and the pulley diameters are nearly equal. (For other drives see rule No. 4.)*

Single Belts —Multiply the belt speed in feet per minute by the width of the belt in inches and multiply that product by 55. Divide this product by 33,000. The quotient will be the amount of horse-power that any good single belt will safely transmit.

Rule No. 2A. *To find the horse-power that double and triple belting will transmit under similar conditions.*

Multiply the result obtained under Rule 2 by 1.6 for double or by 2 for triple belting.

Rule No. 3. *To find the width of belting.*

Multiply the given horse-power by 33,000 and divide this product by the result obtained by multiplying the belt speed in feet per minute by 55 for single, 88 for double or 110 for three-ply. The quotient will be the width of the belting required.

NOTE: Rules No. 2 and No. 3 apply where arc of contact or angle of wrap of belt around pully is 180° i. e., where diameters of belt pulleys are nearly equal.

The horse-power which belting will transmit is determined by multiplying the effective pull in pounds per inch of width by the width of the belt in inches and the speed of the belt in feet per minute, dividing this product by 33,000. In Rule No. 2 it will be seen that 55 pounds is the effective pull, or the force which tends to turn the pulleys. The effective pull is the difference in tension between the tight and slack sides of the belt. It depends to a great extent on the arc of contact of the belt on the smaller pulley. With an arc of contact of 180° 55 pounds per inch of width is a safe value for a single belt.

Where the arc of contact is not 180° or approximately that angle, it is necessary to make an allowance in figuring the horse-power which a belt will trans-

mit. This necessitates a new value for the effective pull to be used in Rule No. 2 in place of 55 which, as above stated, is the safe value for the effective pull of a single belt 1″ wide with an arc of contact of 180°.

Rule No. 4. *To find the horse-power belting will transmit under any conditions.*

Use Rules No. 5 and No. 2 as explained below:

Find the effective pull under rule No. 5, substitute the value thus obtained for 55 in rule No. 2 for single belting. Multiply the above result by 1.6 for double, and by 2 for three-ply belting.

Rule No. 5. *To find the effective pull where the arc of contact is not* 180°.

Multiply the arc of contact, (determined in accordance with Rule No. 6), by 55, and divide this product by 180. This is for single belting. Multiply by 1.6 for double or by 2 for triple belting.

Rule No. 6. *To find the arc of contact on the smaller pulley when the drive is open and without idlers.*

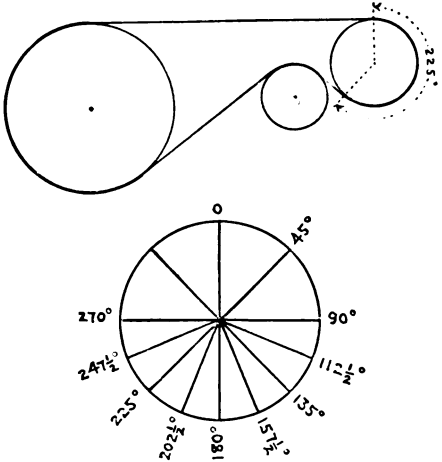
The number of degrees in the arc of contact can be arrived at by multiplying the difference between the diameters of the pulleys in inches by 4.75, dividing the product by the distance between the pulley centers in feet and subtracting the quotient from 180.

Example—To find the arc of contact, having given the pulley diameters of 10″ and 36″ and the center distance between pulleys 12 feet.

Arc of contact equals $180 - \frac{26 \times 4.75}{12} = 169.71°$

Rule No. 6A. *To find the arc of contact for smaller driving or driven pulley in the case of open drives with idler pulleys, cross belt drives, quarter-turn drives, etc.*

The drive must be laid out to scale, the arc of contact measured and the actual contact of belt on smaller pulley compared with diagram below.



Rule No. 7. *To find the required width of belting in cases where pulley diameters are not equal.*

Use Rules No. 5 and No. 3 as explained below.

Find the effective pull by means of rule No. 5 and, substitute the value obtained in place of 55 for single, 88 for double and 110 for three-ply in rule No. 3.

We construct belts especially for quarter-turn drives.

Example No. 1

A 17″ Double Belt drives from a jackshaft to a line shaft, the total load on which is 100 H. P. The driving pulley is 30″ Diameter x 18″ face and the speed of same is 290 R. P. M. The receiving pulley is 32″ Diameter x 18″ face. The distance between centers is 28 feet. The drive is open and without idlers. Is the belt large enough to carry the load?

The pulleys being of nearly equal diameter and the distance between centers not short, Rules No. 1, 2 and 2A are to be used.

First—By Rule No. 1. Find belt speed.

$$\frac{30}{12} \times 3.1416 \times 290 = 2277.66 \text{ Ft. per Min.}$$

Second—By Rule No. 2. Find H.P. of a 17″ Single Belt at 2277.66 Ft. per Min.

$$\frac{2277.66 \times 17 \times 55}{33{,}000} = 64.53 \text{ H. P.}$$

Third—By Rule No. 2A. H.P. of a 17″ Double Belt = H. P. of Single Belt x 1.6.

$$64.53 \times 1.6 = 103.25 \text{ H. P.}$$

The 17″ double belt is large enough to do the work.

Example No. 2

A volume exhaustor which requires 19 H. P. has a 10″ Diameter x 5″ face pulley, and is driven by a 4″ Single Belt from a 48″ Diameter x 5″ face pulley on a countershaft making 280 R. P. M. The distance between shaft centers is 10 feet. The drive is open and without idlers.

Is belt large enough to do the work?

First—By Rule No. 1. Find the belt speed.

$$\frac{48}{12} \times 3.1416 \times 280 = 3518.592 \text{ Ft. per Min.}$$

The pulley Diameters are not equal, therefore, to find the H. P., Rule No. 4 must be used. The effective pull must be found by Rule No. 5, after finding arc of contact by Rule No. 6.

Second—By Rule No. 6. Find the arc of contact.

NOTE: The difference between the diameter of the large pulley, 48″, and the small pulley, 10″, is 38″.

$$180 - \frac{38 \times 4.75}{10} = 162°$$

Third—By Rule 5. Find the effective pull.

$$\frac{162 \times 55}{180} = 49.5 \text{ for Single Belt.}$$

Fourth—By Rule No. 4. Substituting 49.5 in Rule No. 2 we have:

$$\frac{3518.592 \times 4 \times 49.5}{33{,}000} = 21.11 \text{ H. P.}$$

The 4″ single belt is large enough to do the work.

Example No. 3

A machine requiring 17 H. P. for operation with a receiving pulley 14″ Diameter x 8″ face is driven from an 18″ Diameter x 8″ face pulley on line shaft which makes 225 R. P. M. Open Drive.

Find width of belt required.

Pulley Diameters are nearly equal, therefore 180° arc of contact should be used.

First—By Rule No. 1. Find the belt speed.

$$\frac{18}{12} \times 3.1416 \times 225 = 1060.29 \text{ Ft. per Min.}$$

By Rule No. 3.

$$\text{Width} = \frac{17 \times 33{,}000}{1060.29 \times 55} = 9.62'' \text{ Single Belt.}$$

As the face of the pulley is only 8" in width, a Double Belt must be used.

By Rule No. 3.

$$\text{Width} = \frac{17 \times 33{,}000}{1060.29 \times 88} = 6.01'' \text{ Double Belt.}$$

A 6" Double Belt will do the work.

Horse-Power of Belt

Rules No. 4, No. 2 and 2A may be expressed numerically by the following formula:

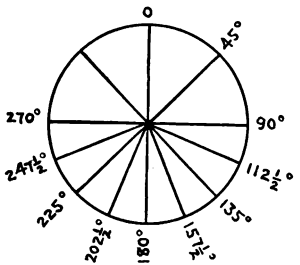
Formula for Horse-Power embodying preceding rules:

$$\frac{\text{F. P. M.} \times \text{W} \times \text{C}}{33{,}000} \times \begin{cases} 1 = \text{H. P. of Single Belt.} \\ 1.6 = \text{" " " Double "} \\ 2 = \text{" " " Three-ply "} \end{cases}$$

F. P. M. = Feet per Minute.

W. = Width.

C. = Constant for effective pull corresponding to number of degrees that belt is in contact with the smaller pulley. See diagram and table.



Table

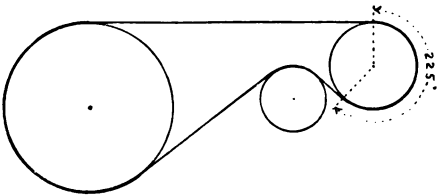
of constants for effective pull corresponding to number of degrees that belt is in contact with pulley.

When arc of contact equals ¼ circle, or 90°, C = 28
When arc of contact equals 112½°, C = 34
When arc of contact equals ⅜ circle, or 135°, C = 41
When arc of contact equals 157½°, C = 48
When arc of contact equals ½ circle, or 180°, C = 55
When arc of contact equals 225°, C = 69
When arc of contact equals ¾ circle, or 270°, C = 83

The arc of contact used in the foregoing table may be found in accordance with Rules No. 6 or No. 6A.

Example

How many horse-power will a 10-inch Double Belt transmit operating over a 40-inch driver and 20-inch receiving pulley with an idler pulley, the driving pulley making 400 revolutions per minute?



Speed of Belt.

With the Diameter of driving pulley in inches, and the number of revolutions of shaft or pulley (secured

by a speed indicator), the corresponding speed of belt in feet per minute is readily found in tables on pages 44 to 47 inclusive. On the drive cited the 40-inch driving pulley making 400 revolutions per minute propels the belt 4,189 feet per minute (see table, page 44).

Arc of Contact and Effective Pull.

Always use the smaller arc of contact. The belt in this case is in contact with the smaller pulley through an arc of 225°, found by comparing the contact of belt on pulley with the diagram, see page 39, showing the degrees of a circle.

For the arc of contact of 225° the effective pull factor for a Single Belt, as per table on preceding page, is 69.

We therefore have as follows:

F. P. M. (Feet per minute), 4,189.

W. (Width), 10" Double Belt.

C. (Effective pull factor), 69.

Horse-power of Single Belt: (Same as Rules No. 4 and No. 2.)

$$\frac{4{,}189 \times 10 \times 69}{33{,}000} = 87.59 \text{ Horse-power.}$$

Horse-power of Double Belt: (Same as Rule No. 2A.)

$$87.59 \times 1.6 = 140.14 \text{ Horse-power.}$$

Conservative Estimate of Horse Power

Transmitted by the Best Oak-Tanned Leather Belting.
Based on 180° arc of contact, using the formula on page 33

SINGLE

Speed in ft. per min.	600	1200	1800	2400	3000	3600	4200	4800	5400	6000
Width of Belt	H	O	R	S	E	P	O	W	E	R
2 in.	2	4	6	8	10	12	14	16	18	20
3 "	3	6	9	12	15	18	21	24	27	30
4 "	4	8	12	16	20	24	28	32	36	40
5 "	5	10	15	20	25	30	35	40	45	50
6 "	6	12	18	24	30	36	42	48	54	60
8 "	8	16	24	32	40	48	56	64	72	80
9 "	9	18	27	36	45	54	63	72	81	90
10 "	10	20	30	40	50	60	70	80	90	100
12 "	12	24	36	48	60	72	84	96	108	120
14 "	14	28	42	56	70	84	98	112	126	140
16 "	16	32	48	64	80	96	112	128	144	160

DOUBLE

Speed in ft. per min.	400	800	1200	1600	2000	2400	2800	3200	3600	4000	5000
Width of Belt	H	O	R	S	E		P	O	W	E	R
4 in.	4	8	13	17	21	25	30	34	38	42	53
6 "	6	13	19	25	32	38	45	51	57	64	80
8 "	8	17	25	34	42	51	60	68	77	85	106
10 "	10	21	32	42	53	64	74	85	96	106	133
12 "	13	25	38	51	64	76	89	102	115	128	160
16 "	17	34	51	68	85	102	119	136	153	170	213
20 "	21	42	64	85	106	128	149	170	192	213	266
24 "	25	51	76	102	128	153	179	205	230	256	320
30 "	32	64	96	128	160	192	224	256	288	320	400
36 "	38	76	115	153	192	230	269	307	345	384	480
40 "	42	85	128	170	213	256	298	341	384	426	533

NOTE. For estimating the H.P. that a leather belt will transmit where the least contact is greater than 180°, use the formula on page 35

Complete stock of belting at each G & K Branch

Rules for Finding the Length of a Belt when it is Inconvenient to use a Tape

1 When both pulleys are of about the same size.

Add the diameters of the two pulleys together, multiply this result by 3.1416, and divide by 2. To this quotient add twice the distance between centers of the shafts and this will give the required length.

2 When one pulley is considerably larger than the other.

Square the distance between the centers of the shafts; add to this the square of the difference between the radii of the two pulleys; extract the square root from this sum and multiply by 2, thus obtaining a result which we will call " A."

Add the diameters of the two pulleys together and multiply this sum by 3.1416; add to one-half of this product the result " A," and you will have the length of the belt required.

3 For Cross Belts.

Square the diameter of the large pulley and the distance between centers; add together and extract the square root.

Square the diameter of the small pulley and the distance between centers; add together and extract the square root.

To the sum of the two roots add one-half the circumference of the two pulleys, and the total will be the required length.

When ordering or inquiring about special belts, be sure and give information requested on pages 49 to 52.

Table of Circumferential Speeds in Feet per Minute

Revolutions per minute

Dia. in In.	75	100	125	150	175	200	225	250	275	300	325	350	375	400
4	78	105	131	157	183	209	236	262	288	314	340	367	393	419
5	98	131	164	196	229	262	295	327	360	393	425	458	491	524
6	118	157	196	236	275	314	353	393	432	471	511	550	589	628
7	138	183	229	275	320	367	412	458	504	550	596	641	687	733
8	157	209	262	314	367	419	471	524	576	628	681	733	785	838
9	177	236	295	353	412	471	530	589	648	707	766	825	884	942
10	196	262	327	393	458	524	589	654	720	785	851	916	982	1047
12	236	314	393	471	550	628	707	785	864	942	1021	1100	1178	1257
14	275	367	458	550	641	733	825	916	1008	1100	1191	1283	1375	1466
15	295	393	491	589	687	785	884	982	1080	1178	1276	1375	1473	1571
16	314	419	524	628	733	838	942	1047	1152	1257	1361	1466	1571	1675
18	353	471	589	707	825	942	1060	1178	1296	1414	1531	1649	1767	1885
20	393	524	654	785	916	1047	1178	1309	1440	1571	1702	1833	1964	2094
22	432	576	720	864	1008	1152	1296	1440	1584	1728	1872	2016	2160	2304
24	471	628	785	942	1100	1257	1414	1571	1728	1885	2042	2199	2356	2513
26	511	681	851	1021	1191	1361	1531	1702	1872	2042	2212	2382	2553	2723
28	550	733	916	1100	1283	1466	1649	1833	2016	2199	2382	2566	2749	2932
30	589	785	982	1178	1375	1571	1767	1964	2160	2356	2553	2749	2945	3142
32	628	838	1047	1257	1466	1675	1885	2094	2304	2513	2723	2932	3142	3351
34	668	890	1113	1335	1558	1780	2003	2225	2448	2670	2893	3115	3338	3560
36	707	942	1178	1414	1649	1885	2121	2356	2592	2827	3063	3299	3534	3770
38	746	995	1244	1492	1741	1990	2238	2487	2736	2985	3233	3482	3731	3979
40	785	1047	1309	1571	1833	2094	2356	2618	2880	3142	3403	3665	3927	4189

Table of Circumferential Speeds in Feet per Minute (Continued)

Revolutions per minute

Dia. in In.	75	100	125	150	175	200	225	250	275	300	325	350	375	400
42	825	1100	1375	1649	1924	2199	2474	2749	3024	3299	3574	3848	4123	4398
44	864	1152	1440	1728	2016	2304	2592	2880	3168	3456	3744	4032	4320	4608
46	903	1204	1505	1806	2108	2408	2710	3011	3312	3613	3914	4215	4516	4817
48	942	1257	1571	1885	2199	2513	2827	3142	3456	3770	4084	4398	4712	5027
54	1060	1414	1767	2121	2474	2827	3181	3534	3888	4241	4595	4948	5302	5655
60	1178	1571	1964	2356	2749	3142	3534	3927	4320	4712	5105	5498	5890	6283
66	1296	1728	2160	2592	3024	3456	3888	4320	4752	5184	5616	6048	6480	
72	1414	1885	2356	2827	3299	3770	4241	4712	5184	5655	6126	6597		
84	1649	2199	2749	3299	3848	4398	4948	5498	6048	6597	7148			
96	1885	2513	3142	3770	4398	5027	5655	6283	6912					
108	2121	2827	3534	4241	4948	5655	6362							
120	2356	3142	3927	4712	5498	6283	7069							
132	2592	3456	4320	5184	6048	6912	7776							
144	2827	3770	4712	5655	6597									
156	3063	4084	5105	6126	7148									
168	3299	4398	5498	6597										
180	3534	4712	5890											
192	3770	5027	6283											
204	4006	5341	6676											
216	4241	5655	7069											
228	4477	5969												
240	4712	6283												

Table of Circumferential Speeds in Feet per Minute (Continued)

Revolutions per minute

Dia. in In.	450	500	550	600	650	700	750	800	850	900	950	1000	1100
4	471	524	576	628	681	733	785	838	890	942	995	1047	1152
5	589	654	720	785	851	916	982	1047	1113	1178	1244	1309	1440
6	707	785	864	942	1021	1100	1178	1257	1335	1414	1492	1571	1728
7	825	916	1008	1100	1191	1283	1375	1466	1558	1649	1741	1833	2016
8	942	1047	1152	1257	1361	1466	1571	1675	1780	1885	1990	2094	2304
9	1060	1178	1296	1414	1531	1649	1767	1885	2003	2121	2238	2356	2592
10	1178	1309	1440	1571	1702	1833	1964	2094	2225	2356	2487	2618	2880
12	1414	1571	1728	1885	2042	2199	2356	2513	2670	2827	2984	3142	3456
14	1649	1833	2016	2199	2382	2566	2749	2932	3115	3299	3482	3665	4032
15	1767	1964	2160	2356	2553	2749	2945	3142	3338	3534	3731	3927	4320
16	1885	2094	2304	2513	2723	2932	3142	3351	3560	3770	3979	4189	4608
18	2121	2356	2592	2827	3063	3299	3534	3770	4006	4241	4477	4712	5184
20	2356	2618	2880	3142	3403	3665	3927	4189	4451	4712	4974	5236	5760
22	2592	2880	3168	3456	3744	4032	4320	4608	4896	5184	5472	5760	6336
24	2827	3142	3456	3770	4084	4398	4712	5027	5341	5655	5969	6283	
26	3063	3403	3744	4084	4424	4764	5105	5445					
28	3299	3665	4032	4398	4764	5131	5498	5864					
30	3534	3927	4320	4712	5105	5498	5890	6283					
32	3770	4189	4608	5027	5445	5864	6283	6702					
34	4006	4451	4896	5341	5785	6231	6676						
36	4241	4712	5184	5655	6126	6597							
38	4477	4974	5472	5969	6466								
40	4712	5236	5760	6283									
42	4948	5498	6048	6597									
44	5184	5760	6336										
46	5419	6021	6623										
48	5655		6283										
54	6362												

Table in Circumferential Speeds in Feet per Minute (Continued)

Revolutions per minute

Dia. in In.	1200	1300	1400	1500	1600	1700	1800	1900	2000	2200	2400
4	1257	1361	1466	1571	1675	1780	1885	1990	2095	2304	2513
5	1571	1702	1833	1964	2094	2225	2356	2487	2618	2880	3142
6	1885	2042	2199	2356	2513	2670	2827	2984	3142	3456	3770
7	2199	2382	2566	2749	2932	3115	3299	3482	3665	4032	4398
8	2513	2723	2932	3142	3351	3560	3770	3979	4189	4608	5027
9	2827	3063	3299	3534	3770	4006	4241	4477	4712	5184	5655
10	3142	3403	3665	3927	4189	4451	4712	4974	5236	5760	6283
12	3770	4084	4398	4712	5027	5341	5655	5969	6283		
14	4398	4764	5131	5498	5864	6231	6597				
15	4712	5105	5498	5890	6283	6676					
16	5027	5445	5864	6283	6702						
18	5655	6126	6597								

Revolutions per minute

Dia. in In.	2600	2800	3000	3200	3400	3600	3800	4000	4400
4	2723	2932	3142	3351	3560	3770	3979	4189	4608
5	3403	3665	3927	4189	4451	4712	4974	5236	5760
6	4084	4398	4712	5027	5341	5655	5969	6283	
7	4764	5131	5498	5864	6231	6597			
8	5445	5864	6283	6702					
9	6126	6597							

Diameter and Circumference of Pulleys

Table is based on the fact that the circumference of a circle equals its diameter multiplied by 3.1416.

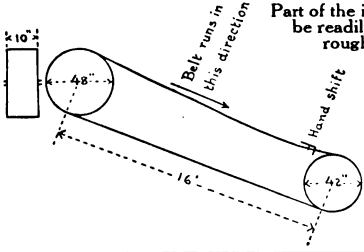
Diam. in In.	Cir. in In.	Cir. in Ft.	Diam. in In.	Cir. in In	Cir. in Ft.
4	12.566	1.047	28	87.965	7.330
5	15.708	1.309	30	94.248	7.854
6	18.850	1.571	32	100.531	8.378
7	21.991	1.833	34	106.814	8.901
8	25.133	2.094	36	113.097	9.425
9	28.274	2.356	38	119.381	9.948
10	31.416	2.618	40	125.664	10.472
11	34.558	2.880	42	131.947	10.996
12	37.699	3.142	44	138.230	11.519
13	40.841	3.403	46	144.513	12.043
14	43.982	3.665	48	150.796	12.566
15	47.124	3.927	50	157.080	13.090
16	50.265	4.189	52	163.363	13.614
17	53.407	4.451	54	169.646	14.137
18	56.549	4.712	56	175.929	14.661
19	59.690	4.974	58	182.212	15.184
20	62.832	5.236	60	188.496	15.708
21	65.973	5.498	62	194.779	16.232
22	69.115	5.760	64	201.062	16.755
23	72.257	6.021	66	207.345	17.279
24	75.398	6.283	68	213.628	17.802
25	78.540	6.545	70	219.911	18.326
26	81.681	6.807	72	226.195	18.850

Properly tanned leather is the most durable belt material

Suit the Belt to the Drive

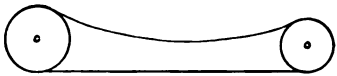
The following questions are compiled to enable us to furnish the best belt for your conditions. It is imperative that we have this information if we are to furnish the most efficient belt.

1. What does the belt drive?
2. Distance center to center of shafts?
3. Diameter and width of driving pulley?
4. Diameter and width of driven pulley?
5. Revolutions per minute of receiving pulley?
6. Least and greatest horse-power the belt is expected to transmit?
7. What drive shown on pages 50 and 51 is similar to your drive? Is it horizontal, vertical or inclined? If inclined what angle to horizontal?
8. Is tight or driving side of belt top or bottom?
9. State if any special conditions exist, such as hand or automatic shipper, idler, flange pulleys, taper cone pulleys, step cone pulleys?
10. Is belt subject to heat, dampness, steam, oil, or acid fumes?
11. Was previous belt single or double, and what grade?
12. How were the ends fastened?
13. How long did it run?
14. If previous belt failed, what was its final condition as indicating reason for failure?

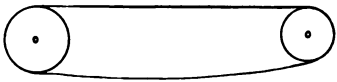


Belt Drives

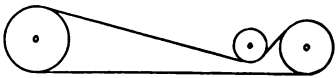
State on orders or inquiries the type of drive on which the belt is to be used, whether it is horizontal, vertical or inclined, and when possible give full answers to questions on page 49.



No. 1 OPEN DRIVE—SLACK ON TOP

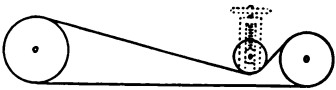


No 2 OPEN DRIVE—SLACK ON BOTTOM



No 3 OPEN DRIVE—WITH FIXED BINDER

No 4 OPEN DRIVE—WITH SWING BINDER



No. 5 OPEN DRIVE—WITH ADJUSTABLE BINDER

Elevation

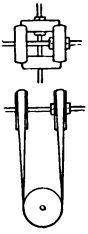
Plan

No. 6 CROSSED-BELT DRIVE

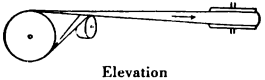
Run belts as slack as they will work efficiently

No. 7 QUARTER-TURN TO LEFT

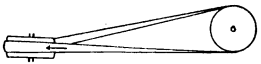
No. 8 QUARTER-TURN TO RIGHT



No. 9 FOUR-PULLEY QUARTER-TURN DRIVE

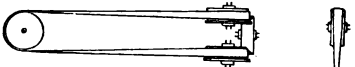


Elevation

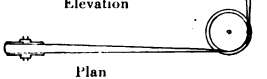


Plan

No. 10 THREE-PULLEY QUARTER-TURN DRIVE

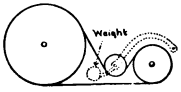


Elevation



Plan

No. 11 MULE DRIVE



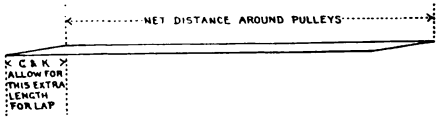
No. 12 LENIX DRIVE

Sticky belt dressings should be avoided

How to Order Belting

In ordering belting specify as below.

1.—LENGTH. State exact net distance around pulleys. Do not give length including lap, for we determine and allow proper additional length for the lap.



2.—ENDS. State whether belt is to be shipped "Endless," or "Square Ends," or "and lap," or (what means the same thing as the last) "lap extra."

3.—WIDTH. State the exact width.

4.—GRADE. State whether Heart, GraKnight, GraKnight Dynamo, Extra Short Lap, Pryzoak, Cylinder, Special Planer, Neptune or Spartan.

5.—PLY. State whether Single, Double or Three-ply.

6.—LAPS. State if other than cemented lap is required. We recommend and guarantee laps cemented only.

7.—FINISH. State whether oil dressed or regular finish is required.

8.—REMARKS. For best results state conditions under which belt is to operate, as specified on Page 49.

Example No. 1. 100 feet and lap of 4½ inches wide, Heart Single Belting, cemented, natural finish.

Example No. 2. 100 feet Endless, 3 inches wide, GraKnight Double Belting, cemented, oil dressed.

Advantages Possessed by Leather Belting as Compared with other forms of Power Transmission

Leather Belting was the primitive method of transmitting power and to-day holds the paramount place among all types of power-transmitting media. To be sure the crude leather belt of the early ages differed greatly from the belt of to-day, but the advances in the art of belt making have easily kept abreast of the times. The various substitutes tried in recent years, such as rubber, canvas, cotton, and balata belts, have only served to emphasize the superior quality of leather belting.

The substitutes, so-called, may be classified under two general heads:—

First—Rubber Belts.

Second—Woven Belts.

Rubber Belts

Rubber belts have been developed in an endeavor to obtain: first, belting cheaper than leather, and second, one which would be water and oilproof. Rubber Belts are generally used where water or other liquids are present. They are seldom employed where conditions are normal, due to their short life and inferior power-transmitting qualities. For damp and wet places Rubber Belts in the past have

been substituted for plain Oak Belts which will not withstand moisture. The necessity for employing Rubber Belts has disappeared since the introduction by leather belt-makers of waterproof leather belts.

While new rubber belting resists the action of water, it soon develops pin holes that permit water and oil to penetrate and disintegrate the fabric, thus ruining the belt. It is in the longer service rendered that special waterproof leather belts demonstrate their economy.

Woven Belts

Woven Belts are either painted with a heavy gummy paint, or material similar to black asphaltum. When so treated new fabric belts are very stiff, do not conform to the pulleys, and consequently do not take up the load as effectively as more pliable belts. The filling used on woven belts makes them fairly waterproof, but it soon dries, cracks, and chips off, so that the belts not only lose their waterproof qualities but have little more value than unfilled or unpainted belts, which, like plain cotton ropes, stretch and shrink with atmospheric changes. The painted or gummed fabric belts, like rubber belts, were introduced to meet the demand for belts that would withstand the action of water and at the same time be cheaper than leather belting. Woven Belts by special treatment have been made for use where subjected to the action of oils. These Woven Belts met the requirements for which they were de-

signed as well as the regular Oak Leather Belting. However, the introduction of belts made from leather of a special tannage, resisting both moisture and oil, has met these requirements and enabled the consumers to reap the advantages of the longer life of leather in this field also.

Authorities on power transmission agree that a good leather belt will transmit from 25 to 40 % more power than fabric or rubber belts. In addition the leather belts possess the flexibility and elasticity so essential to long life and efficient transmission of power. After a leather belt has served its purpose as a belt it still has a large scrap value, whereas a discarded woven or rubber belt is practically worthless.

Leather Belts are made from different tannages of leather and constructed to meet the conditions under which they will operate. For ordinary inside work, where no unusual conditions exist, the regular oak leather belt is well adapted. To resist the destructive effect of water, oil, steam and acid fumes, excessive heat or other abusive treatment, specially tanned and constructed belts are available and necessary.

Other types of power transmission calculated to improve upon leather belting may be classified as follows:

Electrical Transmission.
Rope Drive Transmission.
Chain Drive Transmission.

Electrical Transmission

The Electrical Transmission of power can be conveniently and economically employed under certain conditions.

First—To utilize water power at a considerable distance from the manufacturing plant where the power is to be used.

Second—To drive machinery in buildings widely scattered, the current being generated in a central station, using either water or steam as the prime mover.

There still remains, however, the problem of how to use the electrical current to the best advantage in the factory. This has to do chiefly with the manner of installing the motors. There are two general methods of connecting electric motors to the producing machines.

First—By the individual drive; where the electric motor is connected to the propelling shaft of the machine directly, or through gears, chain, or an elastic pliable belt.

Second—By the so-called group drive, where the driving motor is connected to the line of shafting or to the countershaft by a belt, and thence by other belts to several machines.

Consider the simplicity and efficiency of the leather belt drive

Individual Motor Drives

First: Motor attached directly to each machine.

A shop so equipped presents a better appearance than it would with machines driven by shafting and belts. This feature has had much to do with the adoption of the individual direct connected motor drive in the past.

It is apparent, however, that the first cost of numerous electric motors, extra repair parts, switch boards, wiring and the cost of repairs and maintenance of these complicated appliances must be greater than that for the simple, properly designed shaft and belt drive. One reason for the high cost of the individual direct connected motor is the necessity of employing a motor large enough to supply the extra power needed to start the machine. After the machine is in operation the large motor running on a light load is neither efficient nor economical. It is self-evident that the liability to breakdown and the time and expense of repairs, are much greater in the case of fifty electric motors and their appliances than in that of fifty leather belts with the requisite shafting for driving that number of machines.

Mr. F. W. Taylor, the authority on shop efficiency, states:

"There is no question that through a term of years the total cost of individual motors and electric wiring, coupled with the maintenance and repairs of this system, will far exceed the first cost of properly designed shafting and belting, plus their mainte-

nance and repairs. There is no question that in many cases the motor drive means in the end additional complications and expense rather than simplicity and economy."

Second: Motor connected by belt to each machine.

Even if the individual drive is adopted some flexible connection between the machine and motor is absolutely essential.

The direct connected motor being a positive drive, both the motor and the machine are subjected to injurious shocks due to the varying loads caused by the different work that the machine is called upon to do. The motor usually suffers first from the sudden strains.

The machine and motor connected by a belt are not so liable to damage due to the sudden sticking of a tool or the jamming of material in its mechanism, because the elastic belt will slip sufficiently to prevent undue and injurious strain.

Group Drive

There are two methods of connecting motors and machines by means of belting.

First—A large motor may be connected to line shafts in the same way that an engine is employed, and drive a whole shop or department. This is a good drive if water power is available. Where it is necessary to install a steam or gas engine and

dynamo the expense is much greater than for equipping with belt connected engine and main shaft.

Second—The machines may be divided into groups of several machines each, the motor being belted to a shaft that drives each group of machines by means of belting. This is known as a "Group Drive," and is the system most generally approved and adopted to-day for utilizing electric current in a factory.

The Group Drive has several advantages.

First—Any group of machines may be run independently as required.

Second—Only two or three extra motors are needed in reserve to replace breakdowns.

Third—With motors of different horse powers on hand the power for any group of machines may be increased or decreased as is required, simply by changing motors.

Fourth—Less capital is invested in motors than is the case where individual direct connected motors are used.

Fifth—The elastic belt from the group shaft to each machine serves as a safeguard against damaging shocks and strains to motor and machines.

Although the belt connected Group Motor Drive is undoubtedly the most economical way to utilize current in a factory, the cost is always larger for a

central power-house, with dynamos and electric transmission to the motors, than for a direct belt-connected steam or gas engine. Unless low cost of current is derived from a water-power, the engine, shaft and belt system is generally much more efficient and economical in operation.

Rope Transmission

Rope Drives are divided into two systems—the English or Multiple System and the American or Continuous Single Rope System. The Continuous System is generally used where the rope is exposed to weather or where the drive is complicated. The absurdity of this system lies in the fact that the operation of the entire mill is dependable upon the strength and wearing qualities of the cross section of but a single rope. With the Multiple System considerable trouble is encountered by the individual ropes breaking due to unequal distribution of the load among the ropes, jumping from one groove to the other, and swaying, unless the slack is constantly taken up. When subjected to uneven loads there is a tendency for the ropes to jump out of the sheaves. It is evident that with leather belting of adequate size the troubles enumerated above are avoided.

While the initial cost of the rope drive is from 10% to 15% less than that of the belt drive, the leather belt is the more durable, so that after a few years' operation the belt drive will prove the more economi-

cal. In the case of rope drives there is a variation in the normal speed of the ropes, due to their uneven wear, which results in what is called a "differential drive," the fast rope doing most of the work, and the slowest, usually tight on what should be the slack side, doing negative work.

After the rope wears out it is worthless; whereas, when leather belting has passed its usefulness in its original position, it may be cut down to narrower sizes from which further service may be derived. When it can no longer be used as belting it still has a large scrap value. In comparing these advantages of the leather belt as against the rope drive, together with the comparison of first cost, cost of renewals and of maintenance, the leather belt is much more reliable and economical.

Chain Transmission

The roller chain has only a limited field. Since it is impracticable for use at speeds greater than 600 feet per minute it must be used where the distance between the centers is short, while its chief advantage is the positiveness of its action. A suitably installed leather belt will operate efficiently at any speed and is as positive in its action as is consistent with safety.

It is claimed for the "silent chain" drive that it is efficient, noiseless and durable. When new, the chain is more quiet than spur gears, but when subjected to even a moderate load, some links wear

faster than others and shortly the drive becomes noisy. The chain and sprockets are soon badly worn and replacement is necessary to save power and get rid of the noise.

Leather Belting is suitable for any drive to which the chain is applicable. The flat belt is generally used, but where the distance between shaft centers is short and the speed reduction ratios large, a " V " Belt is employed. The chain drive is limited to a speed not exceeding 1,300 feet per minute. The belt may be relied upon to operate at any speed employed in transmitting power.

Pulleys and belt cost much less to install than sprockets and chain, which must be replaced more frequently than belting.

Summary

The merits of leather belting over all other means of transmitting power may be summed up as follows:

Most economical to maintain.
Easiest to maintain at high efficiency.
Most economical in power consumption.
Most reliable in operation.
Least expensive in the long run.

To Our Patrons and Friends

Hundreds of visitors from all over the world, representing industries of practically every description, are entertained at our plant each year.

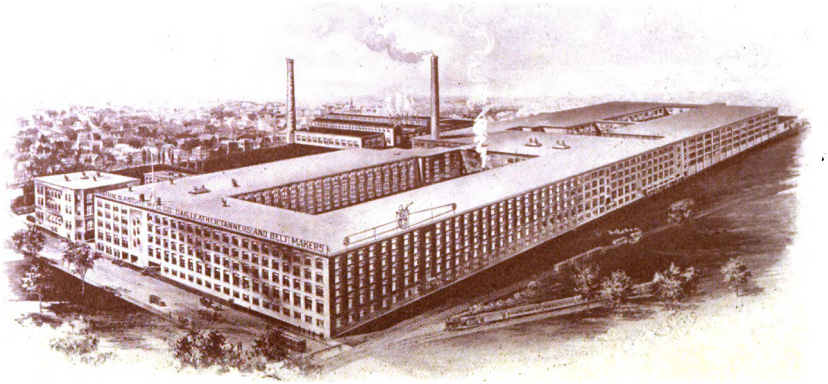
To every user of leather belting and associated products, we extend a standing and cordial invitation to visit our factory to investigate our modern and unsurpassed tanning and manufacturing facilities. You will receive a hearty welcome and every effort will be made to assure you of a pleasant and interesting visit. A competent guide will take pleasure in showing you the particular things and operations in which you are especially interested.

It is obvious, however, that it will be inconvenient for every one to accept this invitation. In fact a great many may never avail themselves of the opportunity of going through our plant where they may observe the different processes necessary to convert hides into leather and the leather into belting.

We have, therefore, embodied in the following pages a few glimpses—snapshots as it were—of the main features of the transformation which we believe will prove particularly interesting to those who cannot come to see us personally.

The Graton & Knight Mfg. Co.

Worcester, Mass., U. S. A.



Home Office and Factories: Worcester, Mass., U. S. A.

The Graton & Knight Mfg. Co.

Worcester, Mass., U. S. A.

Established in 1851, incorporated in 1872 with a capital of $100,000, we now have a paid-in capital of $2,000,000, thus showing a steady and substantial growth.

The extensive stock of finished belting and sundries which we carry at our Worcester, Cleveland, and Detroit factories enables us to make shipment immediately upon receipt of orders.

The complete stock of belting and sundries carried at each of our branches affords exceptional facilities for quickly and satisfactorily supplying the requirements of our patrons.

Each branch is thoroughly equipped to install or repair belts on short notice. Competent repair men and belting experts are always in readiness at our factories and branches. Their services are available days, nights, Sundays and holidays.

Branch Factories

Cleveland, Ohio, Detroit, Mich.

Branch Stores

Atlanta, Ga.	Kansas City, Mo.	Philadelphia, Pa.
Boston, Mass.	Minneapolis, Minn.	Pittsburg, Pa.
Chicago, Ill.	New Orleans, La.	Portland, Ore.
Fall River, Mass.	New York, N. Y.	St. Louis, Mo.

Leicester, England Seattle, Wash.

Selling Agents

Graton & Knight Mfg. Co., of Texas
Dallas, Texas

Graton & Knight Mfg. Co., of Wisconsin
Milwaukee, Wisconsin

Graton & Knight Mfg. Co., of California
San Francisco, California

Tannery Department

Our first tannery, built in 1867 with a capacity of only a few hundred hides annually, has been enlarged until now it has a capacity of over 250,000 hides per annum.

During our entire experience we have never swerved from our original purpose to produce the best belting leather possible; a leather possessing the essential characteristics of pliability, firmness, with minimum stretch, maximum tensile strength and durability.

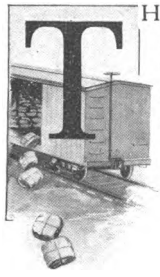
To accomplish this end we buy those hides and raw materials which experience has taught us bring the desired results. The raw materials are subjected to the most rigid laboratory tests to determine beyond question that they contain all the ingredients necessary, and that they are of proper quality and proportion.

The process of treating the hides with tanning materials is carefully watched by a tanner of long experience. He closely follows each step and sees to it that the hides go through the procedure which has proven to give the best results.

Our method of tanning is the long time process, slow, uniform and developed expressly for belting purposes. It produces for us leather which is not excelled in strength of fibre, in durability or in wearing qualities.

In short, "G & K Tannage" is a synonym for the best that can be obtained in belting leather.

The following pages illustrate a few of the many operations necessary to convert hides into leather.

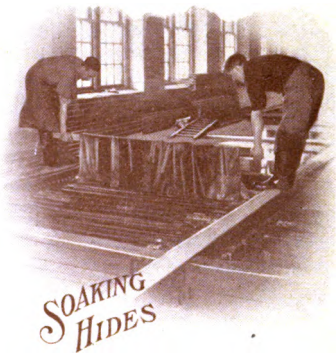


THE "Unloading of the Hides" into the hide cellar may be considered the first step, yet we must not overlook the fact that the animal on which the hide grew, the season of the year when the animal was killed, and the manner in which the hide was taken off, have a wonderful bearing on the quality of the finished product.

The hides from native steers, killed in the short haired season by Armour, Morris, Swift, Cudahy, and other big packers, are unsurpassed except when extra heavy leather is desired. To meet this latter requirement, hides taken from extra heavy Continental steers are imported. The tanner who would buy his hides only as he needs them cannot be expected to produce the best leather. The tanner who in the short-haired season—the summer months—fills his hide cellar, and provides for a year's wants, is the tanner who will furnish the best belting leather.

When the hides are removed from the hide cellar, preparatory to the tanning, they are marked with a steel die, which permits the tracing of any particular lot of hides through the entire tannery and factory.

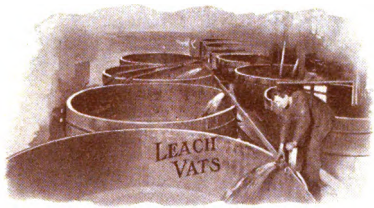
After the hides have been marked they are hung into vats of running water to clean them. Following this soaking, they are laid across beams, where men take off such portions of the flesh as may still cling to the hides.



With the flesh side thoroughly cleaned, there yet remains the hair—which, too, must be taken off. To accomplish this, the hides are laid into a solution of lime-water. After the removal of the hair, the hides are once more laid across beams, where men, with blunt instruments clean the hair or grain side

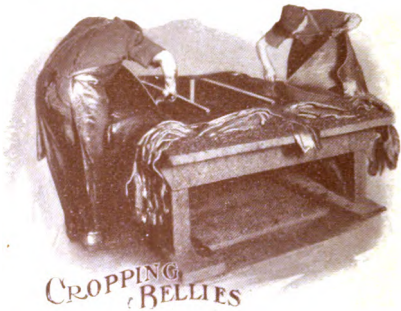
Another bath removes any possible accumulation of lime, and with both sides cleansed and all hair removed, the hides are now ready for the Tanning.

To prepare the tanning liquor, the " leach " house, with its immense vats, is necessary. Here the ground oak bark undergoes the process which separates from it the tanning substance.



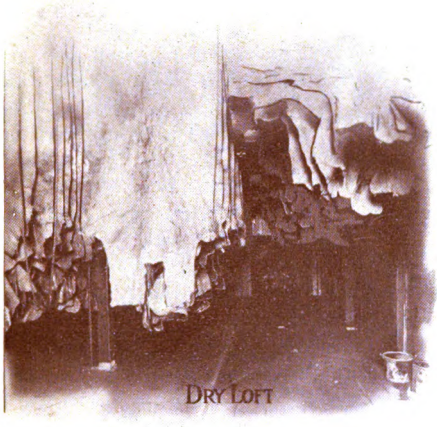
The liquor prepared, the hides ready, we now attach the hides to narrow sticks, and place these sticks across the receiving vats. Here the hides remain until the pores are thoroughly opened,—an important feature in the producing of firm belting leather.

Upon the removal of the hides from these vats, the belly portions are cropped off and are tanned separately for use in our shoe counter department.



The butt portions intended for belting are laid flat, with a layer of bark between them, in what we call "lay-away" vats. They are then covered with the oak tanning liquor.

After the hides have been thoroughly tanned they are taken from these vats, are washed, then skived, so as to remove the surplus parts of flesh which may have remained on the hide during the tanning process, and are then oiled and hung in the " dry loft."



DRY LOFT

Leather Belting Department

In 1851 we commenced the manufacture of leather belting. We have constantly and rigidly adhered to our original purpose and ambition to produce leather belting wh ich will give unequalled service

Our success is attested by the fact that our business has grown to such proportions that we now enjoy a world-wide distribution—our products are used in all quarters of the globe.

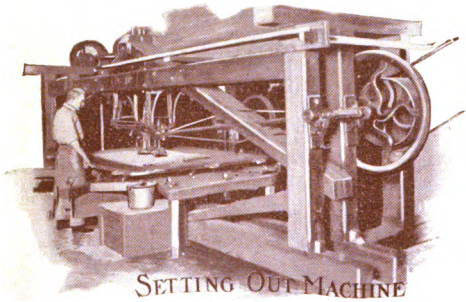
Our plant is conceded to be the largest and best equipped in the world for tanning and currying hides and manufacturing the leather into belting.

The following pages illustrate a few of the processes necessary to convert leather into belting; they also describe the several brands of leather belting which we manufacture and show facsimiles of their respective Trade Marks.

When dry, the hides receive the final trimming, which is the elimination of all the poorer portions, retaining the center, which is the best part, exclusively for belting.

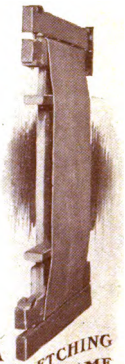
TRIMMING

The trimming done, the belting portion of the hide is now washed and treated with sufficient grease to make it soft and pliable and then placed on what is known as a " setting-out " machine. This gives a preliminary finish to the belting leather, in that it sets out or flattens it.

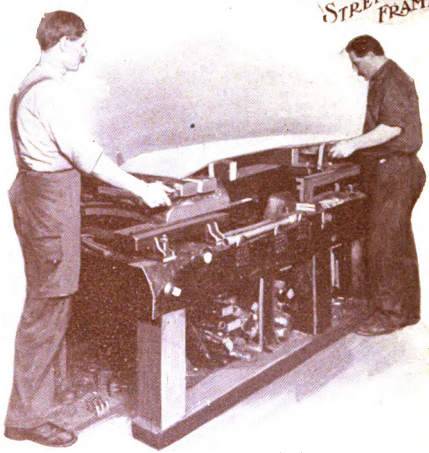


SETTING OUT MACHINE

The leather is then cut into different widths which, while wet, are placed on our patent stretching device, one piece at a time, and stretched, each according to its tensile strength. Each piece remains under full tension until it is thoroughly dry, thus avoiding the stretching to excess of the leather after it is made into belting.

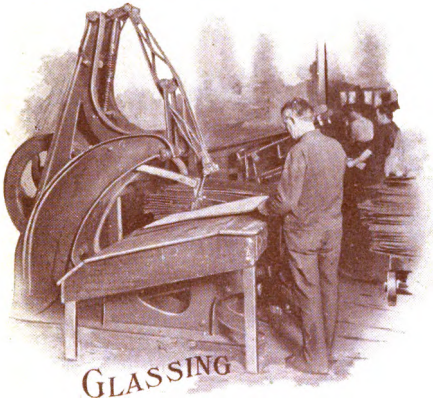


A STRETCHING FRAME



STRETCHING

Once again, and for the last time, the grain or hair side is given a special finish, known to the trade as "glassing." This is what gives the finished belting a nice glossy appearance.

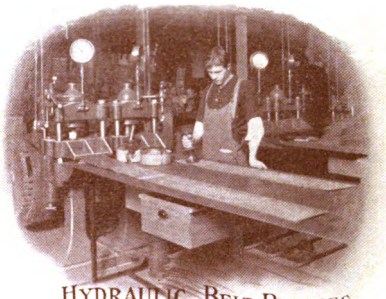


GLASSING

We now bring the stock into the belt factory, where the strips, after being cut into perhaps still narrower widths, are sorted. The matching of the pieces—so as to get strips of the same relative thickness and quality into the same belt—is the work of an expert; careful inspection is part of his duty.

CUTTING BELTING STRIPS

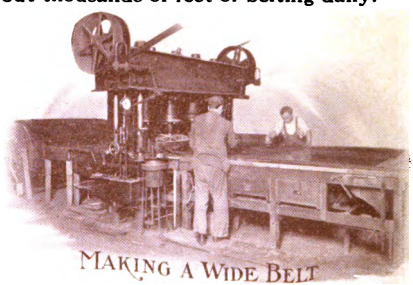
The ends of the strips are now scarfed—shaved down—so as to make a splice of uniform thickness, and brought to the "pressman." He sizes the scarfed ends or laps with cement that has been thoroughly tested for tensile strength and "sticking" qualities. This, too, is work that requires the exercising of great care, for an improperly made



HYDRAULIC BELT PRESSES

lap is sufficient to condemn an entire belt, yes, to ruin the machinery which it may be called upon to operate.

Our many presses, some suited for narrow widths, others for belts as wide as 84 inches, enable us to turn out thousands of feet of belting daily.

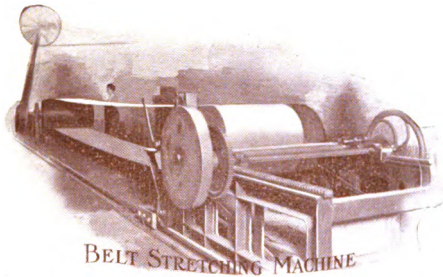


MAKING A WIDE BELT

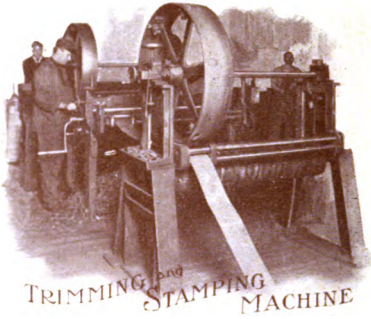
Not only do we inspect the leather before it is made into belting, but we inspect the belting after it leaves the " pressman " to make sure that no belt leaves our factory that is not up to the required standard—with every lap straight and properly cemented.

INSPECTING

The large stretching machine takes the excessive stretch out of the belts and also supplements the work of the inspectors in that it is a means of determining whether every lap is secure, also whether the belt runs perfectly straight.



BELT STRETCHING MACHINE



TRIMMING and STAMPING MACHINE

The trimming machine, which trims the edges of the belt, and also stamps our name and trade mark on every ten feet of belting, prepares the belt for stock or the shipping room.

AISLE in STOCK ROOM

Our belting is rigidly graded, and each brand is of strictly uniform quality. This enables every customer to know just what he is buying, and to select the proper equipment for each individual machine.

Each brand is stamped with the two trade marks shown on this page, as well as with its individual Brand Trade Mark—see following pages.

First Quality Brands

HEART, GRAKNIGHT and GRAKNIGHT DYNAMO all are brands of strictly first quality belting, cut from center stock of the choicest Oak Tanned leather. These three brands differ only in the weight and consequent thickness of the leather used in their construction.

HEART

is First Quality center stock belting made in all plies. Singles weigh from 16 to 18 ounces and doubles from 29 to 33 ounces per square foot, varying according to width. The many years of successful service of Heart Belting in thousands of plants bear testimony to the superior workmanship and high quality center stock entering into its construction. Wherever heavy belting is required, full dependence may be placed upon "Heart Brand."

GRAKNIGHT

is First Quality center stock belting made in all plies. Singles weigh from 14 to 16 ounces and doubles from 26 to 29 ounces per square foot, varying according to width. The very name, GraKnight, coined from our own firm name, is a sufficient guarantee that nothing but choice center stock enters into its makeup.

GRAKNIGHT DYNAMO

is First Quality center stock belting furnished principally in doubles. Singles weigh from 12 to 14 ounces and doubles from 22 to 26 ounces per square foot varying according to width. GraKnight Dynamo Belting is constructed especially for use on high speed machinery, such as motors, fans, blowers, generators, etc. It is of uniform thickness, well balanced, and can be depended upon for long and efficient service.

GUARANTEED
FIRST QUALITY

On every ten feet of Heart, GraKnight and Gra-Knight Dynamo Belting appears the individual brand Trade Mark and the stamp " Guaranteed First Quality."

Second Quality Brands

EXTRA SHORT LAP and PRYZOAK are what we term second quality brands of belting. They are cut from a good selection of side stock Oak Tanned leather. These two brands differ only in the weight of leather used in their construction.

EXTRA SHORT LAP

is made in both singles and doubles, but not over 6" in width. Singles weigh from 16 to 18 ounces and doubles from 29 to 33 ounces per square foot, varying according to width. Extra Short Lap Belting is used with great success under conditions where the work does not require strictly first quality belting.

PRYZOAK

is made in both singles and doubles, but not over 6" in width. Singles weigh from 14 to 16 ounces and doubles from 26 to 29 ounces per square foot, varying according to width.

CYLINDER BELTING

is made from selected well stretched Oak Tanned shoulders. Although this brand is made in both singles and doubles, it is used principally in doubles. Cylinder Belting is carefully constructed and well adapted for light work. It is a very popular belting for agricultural purposes in general.

On every ten feet of Extra Short Lap, Pryzoak and Cylinder Belting appears the individual Brand Trade Mark.

Waterproof Leather Belting

NEPTUNE

is the PIONEER Waterproof Leather Belting, first brought out in 1902. It is strictly first quality belting, made in all plies and cut from center stock of the choicest Oak Tanned leather. It is put together with our Neptune brand of cement which is absolutely impervious to water.

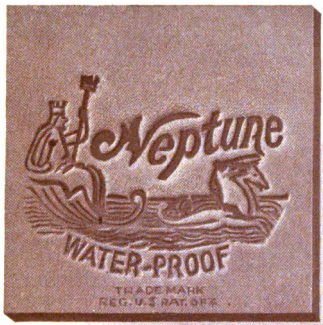
Neptune belting is made for use wherever dampness or water is present, for exposure to rain, snow and other climatic conditions. It has been wholly submerged in water for hours and days at a time—frozen solid in ice—it has always stood the test. While Neptune belting is made primarily for use in damp and wet places, it has proved very efficient for use under such difficult situations as high speed wood-working machinery.

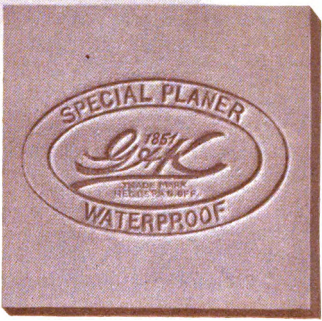
SPECIAL PLANER

is a special Waterproof Belt, strictly first quality, and cut from center stock of the choicest Oak Tanned leather. It is extra heavy in weight, averaging 19 to 24 ounces per square foot, made in single thickness only, and not over 4″ in width. It is designed particularly for heavy work with high speed and small pulleys, such as side and top heads of planers, emery wheel drives, linter drives for cotton-seed oil mills, gin drives for cotton gins, flour mill drives, cones, spindles and spinning frames in cotton and woolen mills.

Neptune and Special Planer Guarantee

We guarantee Neptune and Special Planer Leather Belting to be absolutely waterproof, that the laps will not loosen, nor will the plies come apart even if wholly submerged in water.





GUARANTEED
FIRST QUALITY

On every ten feet of Neptune and Special Planer Belting appears the individual brand Trade Mark and the stamp " Guaranteed First Quality."

We Guarantee

that the leather used in the construction of the foregoing brands of belting is Oak Tanned by the long-time process, and is absolutely free from any ingredients for quickening the process or increasing the weight; if any defects, either in material or workmanship, appear in our belting when used under proper mechanical conditions, we agree, if notified promptly, to replace or repair such defective parts without cost to the purchaser.

The Graton & Knight Mfg. Co.

Worcester, Mass., U. S. A.

Spartan Belting

is a unique belting made in all plies from leather tanned particularly to withstand the effects of steam, water, oil, heat, and gas or acid fumes.

It possesses unusual pliability and tensile strength, thus enabling it to grip the pulley perfectly, and to transmit a maximum amount of power at a minimum cost for operation.

Spartan Belting is made particularly for hard service—for use wherever the requirements are extremely exacting—for use under those conditions which quickly ruin ordinary belting.

It is especially adapted for use in Saw and Planing Mills, Wood Working Plants, Paper and Pulp Mills, Iron and Steel Mills, Forging Plants, Cement Mills, Cotton and Woolen Mills, Bleach and Dye Houses, Tanneries, Canning Factories, and wherever the conditions are unusual and extremely severe.

(Spartan Guarantee on next Page.)

GUARANTEED
FIRST QUALITY

On every ten feet of Spartan Belting appears the Trade Mark and the Stamp "Guaranteed First Quality."

Spartan Guarantee

We guarantee that Spartan Belting will withstand exposure to either hot or cold air water, steam, oil, gases or acid fumes:

That owing to its unusual pliability and a very high co-efficient of friction, it will transmit power with less tension on the bearings, thus making a material reduction in the load due to friction:

That under proper mechanical conditions it will transmit power with greater economy than any other material in use:

That it will, when used under the same conditions, outwear any other belting material, saving loss of time and cost of replacement.

If any defects, either in material or workmanship, appear in Spartan Belting when used under proper mechanical conditions, we agree, if notified promptly, to replace or repair such defective parts without cost to the purchaser.

The Graton & Knight Mfg. Co.

Worcester, Mass., U. S. A.

Leather Belting Price List

Adopted November 21, 1906

Price per Lineal Foot, Single Thickness. Twice the Price of Single Belts.

½	inch	$0.12	7	inch	$1.68	29	inch	$6.96
⅝	"	.15	8	"	1.92	30	"	7.20
¾	"	.18	9	"	2.16	32	"	7.68
⅞	"	.21	10	"	2.40	34	"	8.16
1	"	.24	11	"	2.64	36	"	8.64
1¼	"	.30	12	"	2.88	38	"	9.12
1½	"	.36	13	"	3.12	40	"	9.60
1¾	"	.42	14	"	3.36	42	"	10.08
2	"	.48	15	"	3.60	44	"	10.56
2¼	"	.54	16	"	3.84	46	"	11.04
2½	"	.60	17	"	4.08	48	"	11.52
2¾	"	.66	18	"	4.32	50	"	12.00
3	"	.72	19	"	4.56	52	"	12.48
3¼	"	.78	20	"	4.80	54	"	12.96
3½	"	.84	21	"	5.04	56	"	13.44
3¾	"	.90	22	"	5.28	60	"	14.40
4	"	.96	23	"	5.52	64	"	15.36
4½	"	1.08	24	"	5.76	68	"	16.32
5	"	1.20	25	"	6.00	72	"	17.28
5½	"	1.32	26	"	6.24	76	"	18.24
6	"	1.44	27	"	6.48	80	"	19.20
6½	"	1.56	28	"	6.72	84	"	20.16

Subject to Discount. Quarter-turn Belts not Guaranteed unless Specially Constructed.

Cut Lace. Price per 100 feet. Adopted January 1, 1915

¼	inch	$2.50	7/16	inch	$4.50	¾	inch	$7.50
5/16	"	3.00	½	"	5.50	⅞	"	9.50
⅜	"	3.75	⅝	"	6.50	1	"	11.00

TWIST ROUND. Mar. 1, 1910. Price per Lin. Ft.

1/8	inch	$.08	3/8	inch	$.27	⅞	inch	$.80
3/16	"	.12	½	"	.38	1	"	.96
¼	"	.17	⅝	"	.48			
5/16	"	.22	¾	"	.60			

Spartan "V" Belts

Short centers and high pulley reductions, in many cases a necessity, have always been a source of annoyance and dissatisfaction.

In an endeavor to solve this problem satisfactorily many forms of transmission media have been employed, such as direct connections, gears, link belts (both leather and steel) and chains in various forms. All these have met with questionable success and have invariably proven very expensive propositions.

Extensive experiments have been made with "V" Belts for this service, using both Oak and Chrome leather, only to find them not generally suited to the service unless pulley diameters are large and physical conditions are ideal. With all these points before us, combined with our experience as belting makers and our knowledge of leather, we have developed the Spartan "V" Belt.

Spartan "V" Belts are made from our famous Spartan Leather (see page 87), a leather of extreme toughness, initial pliability, tensile strength, and high resistance to unfavorable conditions. Spartan "V" Belts, therefore, give long life under the severest usage—they are guaranteed to withstand exposure to hot or cold air, water, steam, oil, gas or acid fumes.

In constructing Spartan "V" Belts two or three plies of leather, depending upon the horse-power to be transmitted, are joined with our water and heat-proof Spartan Cement. This built-up section, which forms the continuous part of the belt, is thoroughly stretched and to it the two-ply "blocks" are steel riveted to give the required depth of friction surface to the sides.

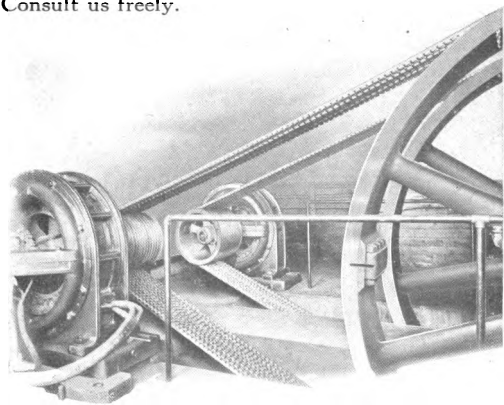
The pliability of the leather, together with the special construction of the "blocks," which are under-cut, enables Spartan "V" Belts to conform

readily to pulleys of small diameter and to transmit power with great economy.

Our successful experience enables us to recommend Spartan "V" Belts for the operation of Ice Machines, Compressors, Pumps, Blowers, Fans, Lighting Systems, Motor Drives with short centers, or for any drive requiring a positive yet flexible transmission.

A few of the advantages of Spartan "V" Belts: they are light in weight and noiseless in operation; flexible yet positive in action; easily installed and removed; require little attention; operate under low initial belt tension; permit efficient installation of small pulleys, high pulley reductions and short distances on centers, and make possible a considerable saving in floor space.

Our Engineering Department is ready to solve any transmission problems and will gladly investigate or design any drive upon request.
Consult us freely.



Two 12 strand 1¼" 6-ply Spartan "V" Belt Drives
each transmitting 150 Horse Power

Leather Packings

In the manufacture of our leather packings we use Oak and Spartan Leather, of our own tannage.

Packings for ordinary conditions are made from Oak leather, unless otherwise ordered. For unusually hard service conditions, we recommend Packings made from Spartan Leather which is manufactured to withstand exposure to heat, steam, water, oil and acid fumes.

In addition to our regular line of packings, we manufacture special cup and valve leathers of any desired shape or size, and in any number of plies.

In ordering special leathers, do not fail to tell us for what purpose they are intended.

Miscellaneous Products

Solid round, patent round and twist round leather belting represent an important factor of our business.

We are also large manufacturers of motorcycle belts, automobile leathers, halters, horseshoe pads, hand leathers, tire sleeves, leather mittens, shoe counters, insoles, outsoles, box toes, welting, and leather strapping of every description. All are products of superior quality, each guaranteed as to material and workmanship.

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The W. B. Crombie Co., Worcester